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Abstract

Ever since their discovery in the American West in 1971, the saber-toothed hooved mammals, belonging to the order Dinocefala have defied placement on the mammalian tree. Previous researchers have suggested a wide range of relationships to insecophytes, rodents, condylarths, proboscids, pinnipeds, and South American xenungulates.

Utilizing a large dataset of characters downloaded from Morphobank, the two best known Middle Eocene ungulates Protungulatum escondense and Protungulatum carinatus were added to a large character matrix of 4,541 morphological characters sampled across 86 other mammalian taxa. Parsimony analysis was performed using nearest-neighbor interchange in Mesquite, as well as search algorithms using TNT to find the most parsimonious placement of Dinocefala among other mammals. Untatheres were found to be most closely related to the xenungulate Caradocia sp. (together as Untatheriomorpha).

If the molecular supported Afrotheria clade is held together, Untatheriomorpha is positioned within Laurasia (Lepus, Phalodon, Carnivora, Pinnipedia and Cetartiodactyla) excluding Chenopods. The most parsimonious tree using TNT search algorithms split the Afrotheria clade across Mammalia, and resulted in the placement of rodents, proboscids, hyraxes and strepsirhines among a polyphyletic ungulate clade including xenungulates. In light of molecular data for living mammals, xenungulates were found within a monophyletic ungulate clade and not closely related to Afrotheria. The early Paleocene South American Protungulatum discovery is the most primitive member of a monophyletic clade that includes Condylartha, Xenungulata, Dinocefala, Cetartiodactyla, and Carnivora. Morphological similarities between proboscids, strepsirhines and xenungulates are likely convergent adaptations.

Untatheres group within other mammalian maxilloyal ungulates, including perissodactyls, phascolistylocondyls, and South American ungulates, suggesting an interchange between North and South America during the early Paleocene, and isolation of Africa.

Untatheres share the following synapomorphies with other maxilloyal ungulates:
1) presence of hoofed dual phalanges, 2) weight loss principally by third metacarpal as central axis of the live and hind foot, 3) loss of the central bone (with no indication of fusion with scaphoid), 4) lack of a deep coryloid focus on the articularis.

The nearest living relatives of untatheres are rhinos, horses and tapirs.

Methods

To investigate the systematic relationships of untatheres, we used TNT (Goloboff et al. 2008) and MP (Farris et al. 1996) algorithms to analyze 4,541 morphological characters from 41 species.

Using published and fossil specimens housed in the Field Museum of Natural History, Chicago, IL, a set of 77 elements from ungulates was collected. These include elements from both the early Paleocene Uintatherium cornutus and the late Paleocene Uintatherium anceps. Additional elements from the Uintatheriamorpha clade were also collected to determine the phylogenetic relationships within this group.

The elements collected included: 1) centrofacial and maxillary bones, 2) dentary, 3) postorbital, 4) postorbital, 5) mandible, 6) ilium, 7) ischium, 8) pubis, 9) femur, 10) tibia, 11) foot, 12) hand, 13) tooth.

Using these elements, we constructed a matrix of 4,541 characters from 86 species. The characters include presence/absence of synapomorphies and synapomorphies with states coded as 0, 1, or 2, indicating the presence of a character state.

The resulting matrix was used to construct trees using TNT and MP algorithms. The resulting trees were used to determine the phylogenetic relationships within the Uintatheria and the relationships among the Uintatheria, the Afrotheria, and the remaining mammals.

The accepted phylogenetic tree is shown in Figure 1. The resulting tree is consistent with previous studies of the Uintatheria, and includes the following clades: 1) Afrotheria, 2) Uintatheria, 3) Eomaia, 4) Sarcidona, 5) Pantodonts, 6) Eubalaena, 7) Lipotes, 8) Caridena, 9) Chalicotheria, 10) Condylartha, 11) Pinnipedia, 12) Carnivora, 13) Eutheria, 14) Mammalia, 15) Marsupialia, 16) Synapsida, 17) Lepidosauria, 18) Reptilia, 19) Crocodylia, 20) Aves, 21) Ornithura, 22) Sauropsida, 23) Amniota, 24) Vertebrata.

The Importance of Ungulate Feet

The Elephant in the Tree (effect of Afrotheria)

The South America Connection

The South America Connection

The Accepted Phylogenetic Tree

The Accepted Phylogenetic Tree

References and Acknowledgements

Watch a video presentation of this research on

https://www.youtube.com/watch?v=14Cc0